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Short Internodes in Western White Pine

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ABSTRACT

Irregularities in growth at the top of western white pine trees were related to three causes: (1) death of the terminal bud while dormant; (2) current-year terminal killed by insects, and (3) succulent terminal broken (usually by birds). In about half the cases, the broken succulent terminal also dies. In all irregularities related to causes 1 and 2, and those of cause 3 where the terminal died, lateral branches turned upward to replace the terminal, resulting in a moderate growth loss. On the broken succulent terminals that survived, one or more fascicular buds appeared. Evidence that such fascicular buds develop into new terminals was seen on growth from preceding years, and it is presumed that those on the current year's growth will also do so. In most cases, however, the internode will be very short for the year in which breakage occurs.

KEYWORDS: western white pine, short internodes, tree top damage, *Pinus monticola*

Western white pine (*Pinus monticola*) is easily identified from a distance because of its distinct and regularly spaced nodes (fig. 1A, B). The nodes are so distinct that measurements of several annual height increments can easily be taken at one time. In taking such measurements, we have frequently noticed that some internodes are much shorter than normal. These internodes are in a size range of several inches (fig. 2A, B, C) as opposed to normal ones of 2 to 3 feet (0.6 to 0.9 m). We have asked several silviculturists, researchers, and forest managers who have had much experience with white pine about the cause of the short internodes, but none could satisfactorily explain the phenomenon. The most frequent explanation offered was that, as a result of death or breaking of the terminal, a lateral branch became dominant.

However, that did not explain what we were seeing. When the terminal dies and one or more laterals become dominant or codominant, the broken dead stub often was still visible. The node was decidedly asymmetrical if a single lateral branch became dominant (fig. 3), or multiple tops resulted if two or more branches became codominant (fig.4). The growth for the year, although reduced, was usually 50 percent or more of normal. In contrast, the length of the short internodes is often less than 25 percent of that of preceding or succeeding "normal" internodes and the branching pattern at the nodes often appears to be nearly normal.

We observed three factors that resulted in irregular height growth of white pines. One was a dead terminal bud (fig. 5). For some reason, most likely insect attack, the bud dies before spring bud break. The second type of damage was caused by an insect attack that killed the terminal during the summer (fig.6). The third kind of damage is a result of terminals broken during the summer (fig.7). The broken and dead stubs often remain visible for several years (fig. 4, 5). As the tree continues to grow, the irregularity is overgrown and only an asymmetrical area remains visible.

We have seen another type of growth irregularity in grand fir (*Abies grandis*) that could also give rise to short internodes but have not observed it in white pine. In grand fir, some terminal buds that appear dead at the normal time for spring bud break are either in an extended dormant state, or are mostly dead but contain some living meristematic tissue that can form a new bud, for they produce a short internode later in the summer. If that shoot can later gain dominance over lateral branches, the result would be a short internode similar to those observed in white pine.

Although we did not actually see the cause of summer terminal breaks in plantations where we made measurements, we have seen what we think is the cause in other plantations. Robins, crows, ravens, bluebirds, even hawks and eagles, have been observed sitting on the terminals of trees. The bigger birds bend the terminals horizontally. The smaller birds (for example, bluebirds and pine siskins) do not seem to be heavy enough to cause much bending. We have seen them land on white

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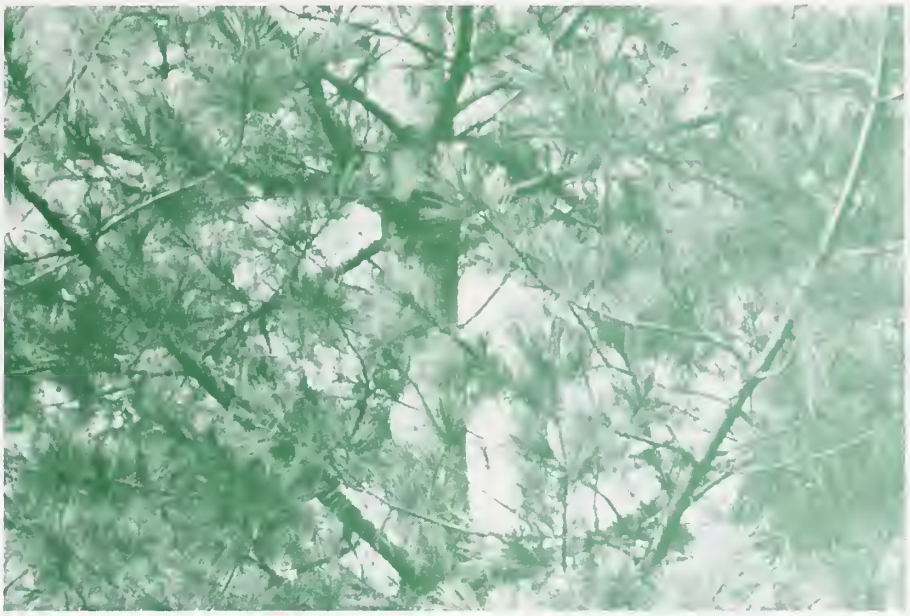
Figure 1.—Western white pine showing regular nodes and internodes: A, naturally regenerated white pine about 60 years old; B, planted white pine, 28 years old.

pine, lodgepole pine (*Pinus contorta*), and ponderosa pine (*Pinus ponderosa*) without causing damage. But we have seen birds the size of robins break succulent terminals.

During the summer of 1983, we measured several years' growth on western white pines in three separate plantations. One of the plantations had a high frequency of irregular tops, and the trees were short enough so we could measure each internode with a meter stick, starting at the top using a 16-ft (4.8-m) orchard ladder; thus, the terminal was at eye level when measured. We were also counting a sample of needles on the terminal so we had to be close enough to handle it.

After we had taken data on several hundred trees, the likely cause of the short internodes became obvious (fig. 8, 9). The short internode usually occurs when the terminal is broken, some of the fascicle buds develop, and one becomes the new terminal. Occasionally the terminal is broken when it has nearly completed elongation and consequently looks normal from the ground (fig. 10). However, a closer look reveals that the terminal has been broken and that many fascicle buds have appeared (fig. 11).

Figure 12 shows a situation where a terminal was broken in 1981 and two buds developed that have been maintaining equal dominance. An irregularity of this type may explain the occasional tree seen in the forest with two nearly identical stems above a certain level. Notice, too, that the 1981 stub (internode) is much shorter than the 1981 growth of any of the laterals. In addition, the node (top of the 1981 break) has no laterals. This lack of lateral branches could easily lead to confusion if one were attempting to measure annual growth increments at some later date, especially if only one bud had developed. The minor irregularity would soon be overgrown and the combination of 1981 stub and 1982 growth would appear to be a single internode rather than two.



A

B

C

Figure 2.—Short internodes in western white pine: A, on an older tree, about 7 inches (17 cm); B, on a younger tree, about 6 inches (15 cm); C, on a younger tree, about 3 inches (7 cm).

Figure 3.—Western white pine with a broken top. Old dead stub is still present. Two lateral branches competed for dominance, but one has outgrown the other.

Figure 4.—The top of this tree was broken during the summer of 1982. Three lateral branches turned up; one usually becomes dominant.

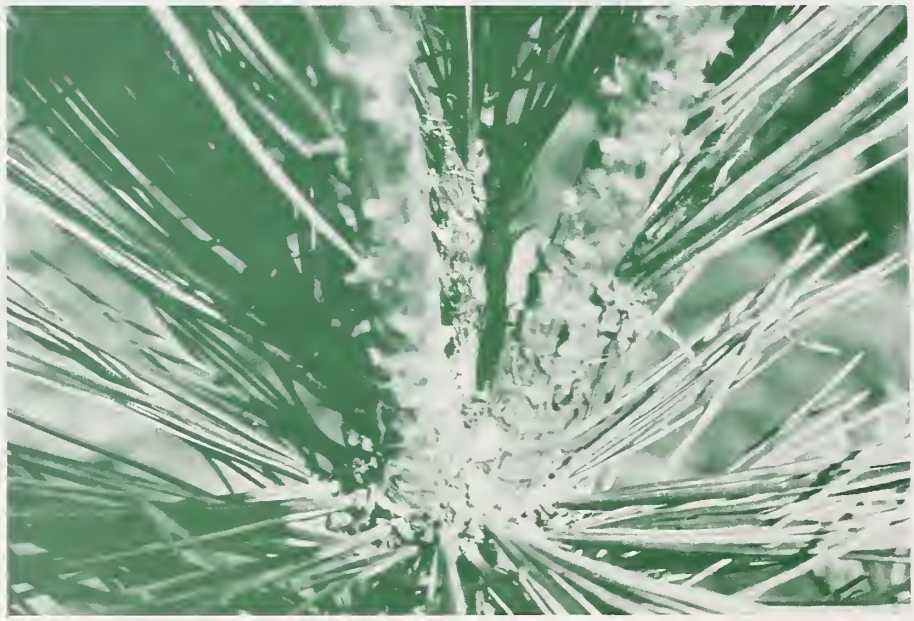


Figure 5.—The dormant terminal bud of this tree died some time before spring.

Figure 6.—The terminal of this tree was killed by insect attack after growing several inches.

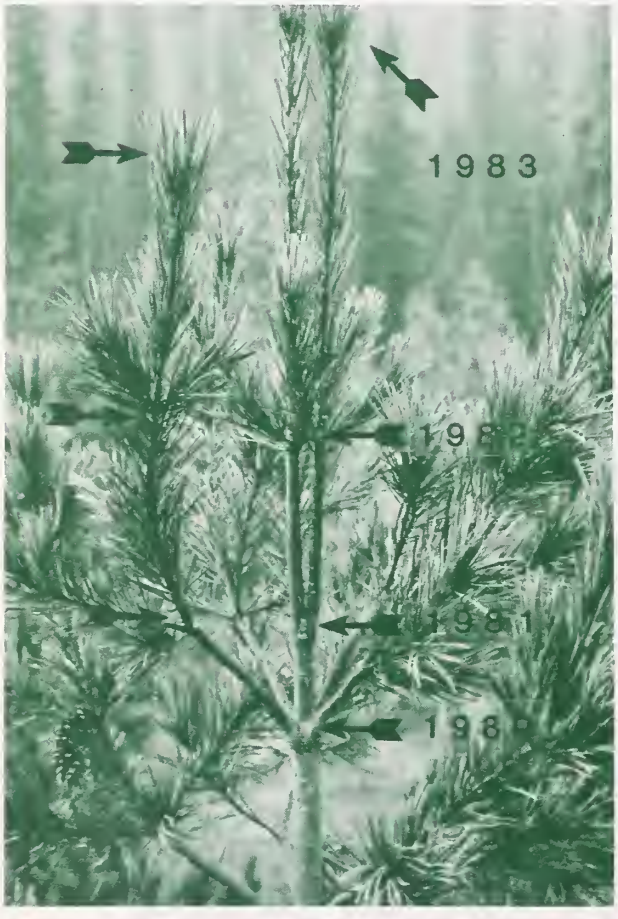
Figure 7.—The top of this tree was broken during the summer of growth, and the stub of the terminal has died.

Figure 8.—The top of this tree was broken during the summer of growth. Three fascicle buds have developed to replace the old terminal. If one can gain dominance over the lateral branches, a short internode will result.

Figure 9.—The top of this tree was broken during the summer of growth. Several fascicle buds have developed.

Figure 10.—The top in this tree appears normal; actually it is broken. See figure 11.

Figure 11.—Top of tree shown in figure 10. The top was broken during the summer. Most of the needles have been stripped away to reveal the buds.



A

B

Figure 12.—A, the top of this tree was broken in 1981. Two fascicle buds developed and the new tops have maintained equal dominance; B, closeup of A.

Table 1.—Top damage and frequency of buds on broken terminals in three western white pine plantations

Plantation	Total trees	Top damage (observed 1983)			
		Dead terminal bud (winter)	Insect killed terminal bud	Broken terminal	Broken terminals with new buds
VQ plot	287	2	12	3	0
Canyon Creek	562	4	1	63	31
Ida Creek	250	4	2	3	1

Frequency of terminal damage and frequency of broken terminals with fascicle buds at the three plantations are tabulated in table 1. After viewing the buds at Canyon Creek, we used binoculars to look at the treetops at the VQ and Ida Creek plots.

The percentage of trees with at least one growth irregularity in the last 6 years was 12 at Ida Creek, 19 at the VQ plot, and 34 at Canyon Creek. These percentages do not include trees with short internodes, unless we could verify that they resulted from terminal breakage and subsequent fascicular bud development.

The point that we want to emphasize is that short internodes often result from summer breakage followed by development of fascicle buds. The reduction in height growth that results is greater than if the broken top had just died and been replaced by a branch. So, in any analyses of height, this and other irregularities must be recognized and an attempt made to compensate for the growth reductions.

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